



THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Gurtej S. Sandhu

Serial No.: 09/023,146

Filed: February 12, 1998

For: TUNGSTEN SILICIDE (WSIx)  
DEPOSITION PROCESS FOR  
SEMICONDUCTOR  
MANUFACTURE

Examiner: T. Dang

Group Art Unit: 2823

Attorney Docket No.: 3369.1US (91-365RE)

#3 of Appeal  
Brief  
PATENT  
4/16/02

NOTICE OF EXPRESS MAILING

Express Mail Mailing Label Number: EL740538463US

Date of Deposit with USPS: April 8, 2002

Person making Deposit: Devin R. Jensen

APPLICANT'S APPEAL BRIEF

RECEIVED  
APR 12 2002  
TECHNOLOGY CENTER 2800

Sirs:

This brief is in furtherance of the Notice of Appeal, filed in this case on February 7, 2002, and is submitted in triplicate in the format of 37 C.F.R. § 1.192(c), and with the fee required by 37 C.F.R. § 1.17(c).

04/10/2002 XDEMESS1 00000068 09023146

04/10/2002

320.00 OP

(1) REAL PARTY IN INTEREST

The real party in interest in the present pending appeal is Micron Technology, Inc., assignee of the pending application as recorded with the United States Patent and Trademark Office on February 10, 1992, at Reel 6011, Frame 355-356.

(2) RELATED APPEALS AND INTERFERENCES

Neither the appellants, the appellants' representative, nor the assignee is aware of any pending appeal or interference which would directly affect, be directly affected by, or have any bearing on the Board's decision in the present pending appeal.

(3) STATUS OF THE CLAIMS

Claims 1 through 47 are pending in the application. Claims 1 through 47 stand rejected and claims 1 through 47 are being appealed.

(4) STATUS OF AMENDMENTS

No amendments have been filed subsequent to the Final Office Action mailed on October 23, 2001. On December 19, 2001 the Applicant filed Remarks under 37 C.F.R. § 1.116 in response to the Examiner's remarks in the Final Office Action mailed October 23, 2001. No amendments were proposed in the Remarks. An Advisory Action mailed January 31, 2002 found the Applicant's arguments in the Remarks unpersuasive and maintained the rejection of claims 1 through 47.

(5) SUMMARY OF THE INVENTION

The present invention involves a process for depositing tungsten silicide on a substrate. More particularly, the present invention embodies processes for depositing tungsten silicide on a substrate by "depositing a tungsten silicide nucleation layer on a substrate using silane as a silicon gas source and then switching to dichlorosilane as the silicon gas source to complete deposition of the tungsten silicide film." *See, Specification* at col. 2, lines 31-36. Using the processes of the present invention, a high quality tungsten silicide film may be deposited at a relatively low temperature in a cold walled chemical vapor deposition (CVD) reaction chamber without requiring plasma enhancement of the CVD process. *See, Specification* at col. 2, line 67 through col. 3, line 3.

A first silicon source gas, silane ( $\text{SiH}_4$ ), may be combined with a reactant gas, tungsten hexaflouride ( $\text{WF}_6$ ), in a CVD process to form "a thin or discontinuous nucleation layer" on the surface of a substrate. *See, Specification* at col. 3, lines 33-35 and lines 60-61. The formation of the nucleation layer of tungsten silicide on the substrate may be accomplished with substrate temperatures "on the order of about 450° C. or less and may be in the range of 200° C. to 500° C." *See, Specification* at col. 4, lines 6-9. "Following formation of the nucleation layer, the source gas is switched and dichlorosilane ( $\text{SiH}_2\text{Cl}_2$ ) is used as the silicon source gas for deposition of the remainder of the tungsten silicide ( $\text{WSi}_x$ ) film." *See, Specification* at col. 3, lines 35-39. Deposition of the tungsten silicide film using dichlorosilane may be accomplished without raising the temperature of the substrate because the initially deposited nucleation layer "allows the subsequent deposition process with the dichlorosilane source gas to also proceed at the lower temperature." *See, Specification* at col. 4, lines 12-17. This differs from prior art

tungsten silicide deposition processes because the temperature of the substrate "is lower than prior art deposition processes using dichlorosilane ( $\text{SiH}_2\text{Cl}_2$ ) as a silicon gas source." *See, Specification* at col. 4, lines 9-11. Furthermore, "with the nucleation layer deposited with a silane source gas there is no need to plasma enhance the (CVD) process." *See, Specification* at col. 4, lines 16-18.

The processes of the present invention may be carried out using a premix chamber for supplying a gas mixture to a CVD reaction chamber for the deposition of a tungsten silicide film. The premix chamber may be coupled to two silicon source gases, a reactant gas, and inert carrier gases for use during a tungsten silicide deposition process. *See, Specification* at col. 3, lines 21-26. "The flowrates of the gases (silicon source, reactant and carrier) can also be controlled to achieve the desired reaction and film quality." *See, Specification* at col. 3, lines 54-56. For instance, "the flow rate of the carrier gases (Ar,  $\text{N}_2$ , He) may be as great as five to ten times the flow rate of the silicon source gas" and "the flow rate of the silicon source gas (either silane or dichlorosilane) in turn may be about 50-100 times the flow rate of the reactant gas." *See, Specification* at col. 3, lines 39-44. The gases mixed in the premix chamber may be directed to the CVD reaction chamber "to react and deposit a uniform film of tungsten silicide ( $\text{WSi}_x$ ) upon the heated surface of the silicon wafers." *See, Specification* at col. 3, lines 45-52.

A tungsten silicide film may be deposited on a substrate using the present invention by first forming a nucleation layer of tungsten silicide using a silane silicon source gas followed by the formation of a tungsten silicide film using a dichlorosilane silicon source gas. For example, a tungsten silicide nucleation layer may be deposited in about 1 to 25 seconds using a CVD process with a substrate temperature of about 450°C, a silane flow rate of about 400 sccm, a reactant gas

flow rate of about 4 sccm and an inert gas flow rate of about 2800 sccm. *See, Specification* at col. 3, lines 57-67. "Following deposition of the nucleation layer the silicon source gas may be switched abruptly or gradually to dichlorosilane and the tungsten silicide film can be deposited to the desired thickness using the dichlorosilane as the source gas." *See, Specification* at col. 3, line 67 through col. 4, line 3. The resulting tungsten silicide film formed by the process of the present invention "is characterized by a low impurity content and by a low stress with the silicon substrate" in addition to "a high quality step coverage." *See, Specification* at col. 4, lines 19-24.

(6) ISSUES

- (a) Whether claims 1 through 47 are unpatentable under 35 U.S.C. § 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention?
- (b) Whether claims 1, 2, 4, 5, 8, 9, 12 through 19, and 21 are unpatentable under 35 U.S.C. § 103(a) as being obvious over Kawanishi et al. (English translation of Japanese Patent JP-39528) taken with Price et al. (United States Pat. 4,632,057)?
- (c) Whether claims 3, 6, 7, 10, 11, 20, 22, and 23 are unpatentable under 35 U.S.C. § 103(a) as being obvious over Kawanishi et al. (English translation of Japanese Patent JP-39528) taken with Price et al. (United States Pat. 4,632,057) as applied to claims 1, 2, 4, 5, 8, 9, 12 through 19, and 21, and in further view of Brors et al. (United States Pat. 4,565,157)?

(7) GROUPING OF CLAIMS

The grouping of the claims is as follows:

(1) With respect to the rejection of claims 1 through 47 under 35 U.S.C. § 112, first paragraph, claims 1 through 47 stand and fall together.

(2) With respect to the rejection of claims 1, 2, 4, 5, 8, 9, 12 through 19, and 21 under 35 U.S.C. § 103(a) as being unpatentable over Kawanishi et al. (English Translation of JP-39528) taken with Price et al. (United States Pat. 4,632,057), the grouping of the claims follows:

(a) Claim 1 recites a process for depositing a tungsten silicide film on a substrate comprising the deposition of a tungsten silicide nucleation layer using a CVD process with a silane silicon source gas and a reactant gas and the deposition of a film of tungsten silicide on the nucleation layer using a CVD process by switching the silicon source gas to dichlorosilane and reacting the dichlorosilane and reactant gas at a temperature of less than about 500 °C, which is not disclosed by the cited references.

(b) Claim 2 stands and falls with claim 1.

(c) Claim 4 stands with claim 1, but does not fall with it since claim 4 further recites “carrying out each of the (CVD) processes at a temperature of about 400 °C. or less” which, in conjunction with claim 1, is not disclosed by the cited references.

(d) Claim 5 stands with claim 1, but does not fall with it since claim 5 recites that the “nucleation layer is formed with discontinuities or to a very thin thickness on the substrate,” which, in conjunction with claim 1, is not disclosed by the cited references.

(e) Claim 8 stands and falls with claim 1.

recites a semiconductor manufacturing process for depositing a tungsten silicide film on a substrate comprising the deposition of a thin or discontinuous nucleation layer of tungsten silicide on the substrate using a CVD process and reacting a silane silicon source gas with a reactant gas mixed in a premix chamber and depositing a film of tungsten silicide on the nucleation layer using a CVD process by switching to dichlorosilane as a silicon source gas to react the dichlorosilane and reactant gas at a temperature of less than about 500 °C, which is not disclosed by the cited references.

(f) Claims 9, 12, 13, and 14 stand and fall with claim 8.

(g) Claim 15 stands with claim 8, but does not fall with it since claim 15 recites a flow rate of the silane silicon source gas of about 400 sccm, a flow rate of the reactant gas being about 4 sccm and a flow rate of the carrier gas being about 2800 sccm, which, in conjunction with claim 8, is not disclosed by the cited references.

(h) Claim 16 stands with claim 1, but does not fall with it since claim 16 recites that the deposition of the nucleation layer of tungsten silicide and the deposition of the film of tungsten silicide occur as a substantially equivalent temperature, which, in conjunction with claim 1, is not disclosed by the cited references.

(i) Claim 17 stands with claim 8, but does not fall with it since claim 17 recites that the deposition of the nucleation layer of tungsten silicide and the deposition of the film of tungsten silicide occur as a substantially equivalent temperature, which, in conjunction with claim 8, is not disclosed by the cited references.

(j) Claim 18 stands with claim 1 but does not fall with it since claim 8 recites a process for depositing a tungsten silicide film on a substrate using a CVD process comprising

introducing a substrate into a reaction chamber of a CVD process, depositing a tungsten silicide nucleation layer on the substrate by introducing a silane silicon source gas and a reactant gas into the reaction chamber to react and form the tungsten silicide nucleation layer, and depositing a film of tungsten silicide on the nucleation layer by switching the silicon source gas to a dichlorosilane silicon source gas such that the dichlorosilane silicon source gas reacts with the reactant gas to form a film of tungsten silicide, wherein the switching of the silicon source gases occurs without interrupting the CVD process and wherein the deposition of the nucleation layer and the film of tungsten silicide occur at a substantially equivalent temperature, which is not disclosed by the cited references.

(k) Claim 19 stands and falls with claim 18.

(l) Claim 21 stands with claim 18, but does not fall with it since claim 21 recites that the deposition of the tungsten silicide nucleation layer and tungsten silicide film is carried out at a temperature of about 400 °C or less, which, in conjunction with claim 18, is not disclosed by the cited references.

(3) With respect to the rejection of claims 3, 6, 7, 10, 11, 20, 22, and 23 under 35 U.S.C. § 103(a) as being unpatentable over Kawanishi et al. taken with Price et al. and further in view of Brors et al. (United States Pat. 4,565,157), the grouping of the claims follows:

(a) Claims 3, 6, and 7 stand and fall with claim 1.

(b) Claims 10 and 11 stand and fall with claim 8.

(c) Claims 20, 22, and 23 stand and fall with claim 18.

(8) ARGUMENT

1. **35 U.S.C. § 112, first paragraph, Rejection**

Claims 1 through 47 stand rejected under 35 U.S.C. § 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor, at the time the application was filed, had possession of the claimed invention. Specifically, the Final Office Action rejects claims 1 through 47 on the basis that the term “tungsten silicide” recited in the independent claims is allegedly overly broad, thereby necessitating one of ordinary skill in the art to “perform tremendous undue experimentations” to carry out the claimed processes.

The Specification satisfies the Applicant’s duty to enable claims 1 through 47. To overcome an enablement rejection an Applicant must demonstrate that the disclosure would have enabled the claims of the invention for one skilled in the art at the time the application was filed. *See, MPEP § 2164.05.* Where “the specification discloses at least one method for making and using the claimed invention that bears a reasonable correlation to the entire scope of the claim, then the enablement requirement of 35 U.S.C. § 112 is satisfied.” *See, MPEP § 2164.01(b)* (*citing In re Fisher, 427 F.2d 833, 839 (CCPA 1970)*). The Specification of the present invention meets this requirement.

The scope of each independent claim of the present invention relates to a process for depositing a tungsten silicide film on a substrate, wherein the process includes the deposition of a nucleation layer of tungsten silicide followed by the deposition of a film of tungsten silicide over the nucleation layer of tungsten silicide by switching to dichlorosilane as the silicon source gas. The Specification discloses at least one method for making and using the claimed invention in

accordance with the scope of the claims. Specifically, the Specification recites:

By way of example and not limitation, at a temperature of about 450 °C. and with a silane flow rate of about 400 sccm, this nucleation layer is deposited in about 1-25 seconds. This requires a flow of reactant gas (WF<sub>6</sub>) of about 4 sccm and a flow of inert gases (Ar, N<sub>2</sub>, He) of about 2800 sccm. Following deposition of the nucleation layer the silicon source gas may be switched abruptly or gradually to dichlorosilane and the tungsten silicide film can be deposited to the desired thickness using the dichlorosilane as the source gas. *See, Specification* at col. 3, line 62 to col. 4, line 3.

The presence of this example in the Specification of the present invention, which discloses a specific method for making and using the claimed invention, is sufficient in and of itself to overcome the outstanding rejection under 35 U.S.C. § 112, first paragraph. *See, MPEP* § 2164.01(b) (*citing In re Fisher*, 427 F.2d 833, 839 (CCPA 1970)). Based on the recitation of the example method in the Specification, the rejection of claims 1 through 47 under 35 U.S.C. § 112, first paragraph, should be withdrawn and the claims allowed for issue.

Claims 1 through 47 should also be allowed over the 35 U.S.C. § 112, first paragraph, rejection because the Office has failed to meet its burden to demonstrate that there is a reasonable basis upon which to question enablement. *See, MPEP* § 2164.04 (*citing In re Wright*, 999 F.2d 1557, 1562 (Fed Cir. 1993)). At a minimum, the Examiner must give reasons for the uncertainty of the enablement. *See, Id.* (*citing In re Bowen*, 492 F.2d 859 (CCPA 1974)). To date, the only reasons given for the uncertainty of the enablement of claims 1 through 47 is that “without defining or specifying numerical values of x [for WSi<sub>x</sub>], one cannot determine the final product so that the invention can be practiced.” *See, Official Action*, Oct. 23, 2001, p. 2 (emphasis added). The flaw in this rejection, however, is that the reason for the rejection is based upon the alleged inability to form a final product. None of claims 1 through 47 claim a final product. Rather, each of the independent claims recite a process for depositing a tungsten silicide film on

a substrate. To use the claimed processes, a value for x in the formula  $WSi_x$  does not need to be known. The Applicant is not claiming all tungsten silicide films formed by the claimed processes, rather, the Applicant claims the recited processes of claims 1 through 47. The claimed processes are enabled by the example previously cited and by the disclosure of the Specification of the present invention.

Corresponding to the basis for the rejection - that a final product cannot be determined - the Official Action indicates that "one having ordinary skill in the art would necessarily perform tremendous undue experimentations" in order to form a  $WSi_x$  which encompasses all forms of tungsten silicide. *See, Official Action, Oct. 23, 2001, p. 3.* Yet, one having ordinary skill in the art would not have to perform tremendous undue experimentations to carry out the processes claimed by claims 1 through 47 because the claims, and the Specification, disclose exactly how to use the claimed processes. For example, with respect to claim 1, the process involves the deposition of a nucleation layer of tungsten silicide on a substrate using CVD process with a silane silicon source gas and a reactant gas. This step may be carried out without knowing what the value of x in the formula of  $WSi_x$  is. Following the deposition of the nucleation layer a film of tungsten silicide may be deposited on the nucleation layer using the CVD process by switching the silane silicon source gas to dichlorosilane such that the dichlorosilane reacts with the reactant gas to form the tungsten silicide film at a temperature of less than about 500 °C. Again, the value of x in the formula of  $WSi_x$  does not need to be known to carry out this step of claim 1. Because the value of x in the formula of  $WSi_x$  does not need to be known to carry out any portion of the process claimed by claim 1, the rejection of claim 1 under 35 U.S.C. § 112, first paragraph, should be withdrawn and the claim should be allowed. Similarly, claims 2

through 47 should be allowed over the 35 U.S.C. § 112, first paragraph, rejection.

Furthermore, a number of factors may be considered when determining whether or not a disclosure fails to satisfy the enablement requirement of 35 U.S.C. § 112, first paragraph, based upon the allegation that undue experimentation would be required to carry out the claimed invention. These factors include: (1) the breadth of the claims; (2) the nature of the invention; (3) the state of the prior art; (4) the level of one of ordinary skill; (5) the level of predictability in the art; (6) the amount of direction provided by the inventor; (7) the existence of working examples; and (8) the quantity of experimentation needed to make or use the invention based on the content of the disclosure. *See, MPEP* § 2164.01(a) (*citing In re Wands*, 858 F.2d 731, 737 (Fed. Cir. 1988)). Analyzing these factors, one having ordinary skill in the art would not have to carry out undue experimentation to use or understand the claimed processes of the present invention.

The breadth of the claims, and nature of the invention, cover a process for depositing a tungsten silicide film. At the time the present application was filed, methods for depositing tungsten silicide films were well known in the prior art. It was known that tungsten silicide films could be deposited on substrates in a chemical vapor deposition (CVD) process using a silicon source gas, such as silane, and a reactant gas, such as tungsten hexafluoride. *See, Specification* at col. 1, lines 33-49. Processes for depositing tungsten silicide films using tungsten hexafluoride and dichlorosilane gases with the aid of plasma reactions were also known. *See, Specification* at col. 1, lines 50-66. Even the specific deposition conditions and flow rates for producing tungsten silicides films represented by the formula  $WSi_x$  were recognized and were well known or available to one having a level of ordinary skill in the art as evidenced by the citations in the

Official Action to Brors (U.S. Pat. 4,851,292) and Ohba (U.S. Pat. 4,902,645). Using the processes claimed by the present invention, known tungsten silicide films could be produced using known flow rates for the silicon source gas and reactant gas. No undue experimentation is necessary to use the processes of the present invention and the claims are enabled.

Although tungsten silicide deposition techniques using CVD processes were known, the processes described and claimed by the present invention were not known. The Specification, however, details the novel and unobvious processes that may be employed to deposit a tungsten silicide film using a CVD reaction chamber and provides sufficient direction to carry out those processes. One having ordinary skill in the art at the time the patent application was filed would be able to easily follow the techniques described by the Specification to carry out the invention claimed. In addition, the Specification discloses working examples of various processes and deposition conditions that may be employed to carry out the present invention. Based upon the disclosure contained within the Specification, one having ordinary skill in the art would not need to carry out any experimentation to deposit a tungsten silicide on a substrate using the processes recited by the claims of the present invention. The factors to be considered when determining whether or not undue experimentation is required weigh in favor of the Applicant, thus claims 1 through 47 are allowable over the rejection.

The recitation of the term “tungsten silicide” in the claims of the present invention does not render the claims unpatentable because the claims recite a process for depositing a tungsten silicide film. Furthermore, at least one working example of the processes claimed is described in the Specification, thereby overcoming any enablement rejection under 35 U.S.C. § 112, first paragraph. Additionally, undue experimentation is not required to carry out the claimed

embodiments of the present invention because one having skill in the art at the time the present application would have been able to easily follow and use the claimed processes to deposit a tungsten silicide film on a substrate. “A specification disclosure which contains a teaching of the manner and process of making and using an invention in terms which correspond in scope to those used in describing and defining the subject matter sought to be patented must be taken as being in compliance with the enablement requirements of 35 U.S.C. § 112.” *See, MPEP* § 2164.04. Thus, claims 1 through 47 are enabled and are allowable over the current 35 U.S.C. § 112, first paragraph rejection.

**2. 35 U.S.C. § 103(a) Obviousness Rejections of Claims 1, 2, 4, 5, 8, 9, 12 through 19, and 21 Based on Japanese Patent No. 2-39528 issued to Kawanishi et al. in view of U.S. Patent 4,632,057 issued to Price et al.**

Kawanishi teaches a two-step tungsten silicide deposition process. A first tungsten silicide film is formed on a substrate in the presence of silane ( $\text{SiH}_4$ ) and tungsten hexaflouride ( $\text{WF}_6$ ) at a temperature of 360°C. The substrate is then transferred to a second reaction chamber wherein a second tungsten silicide deposition is carried out in the presence of dichlorosilane ( $\text{SiH}_2\text{Cl}_2$ ) and tungsten hexaflouride ( $\text{WF}_6$ ) at a temperature of 680°C. *See, Kawanishi* at 6. Kawanishi makes it clear that the first deposition is a low-temperature deposition and the second deposition is a high-temperature deposition. Kawanishi also notes that a low-temperature deposition followed by a high-temperature deposition is preferred because low-temperature depositions alone are disadvantageous. *See, Kawanishi* at 4.

Price et al. teach a one-step tungsten silicide deposition process initiated by a plasma discharge within a deposition chamber. Price et al. clearly teach that “the plasma discharge

appears necessary to initiate/nucleate deposition.” *See, Price et al.* at col. 5, lines 60-63 (emphasis added). The single-step deposition process occurs in the presence of dichlorosilane ( $\text{SiH}_2\text{Cl}_2$ ) and tungsten hexaflouride ( $\text{WF}_6$ ) at a temperature of 450°C after deposition initiation is triggered by plasma discharge. *See, Price et al.* at col. 9, lines 1-12. Hence, Price et al. imply that a low temperature deposition using dichlorosilane and tungsten hexaflouride is not possible without a plasma discharge.

(a) Claim 1

Claim 1 stands rejected under 35 U.S.C. § 103(a) as being obvious in light of Kawanishi when read in view of Price et al. Claim 1 specifically recites the following limitation:

depositing a film of tungsten silicide on the nucleation layer using a (CVD) process by switching to dichlorosilane ( $\text{SiH}_2\text{Cl}_2$ ) as a silicon source gas such that the dichlorosilane gas reacts with the reactant gas to form the tungsten silicide film at a temperature of less than about 500 °C.

The Office has recognized the fact that Kawanishi fails to teach or suggest the deposition of a tungsten silicide film using dichlorosilane as a silicon source gas at a temperature below 500 °C as recited by the limitation in claim 1. *See, Official Action, Oct. 23, 2001, p. 4.* To overcome Kawanishi’s failure to teach or suggest all of the claim limitations and establish a *prima facie* case of obviousness, the Office relies upon the disclosure of Price et al. However, no motivation exists in the references or in the prior art to combine the teachings of Price et al. with Kawanishi to make obvious the present invention.

A *prima facie* obviousness rejection requires “some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or combine reference teachings.” *See, In re Vaeck*, 947 F.2d 488, 20

USPQ2d 1438 (Fed. Cir. 1991). No motivation exists in the cited references to combine Kawanishi and Price et al. to make obvious claim 1.

Kawanishi provides no motivation to attempt to deposit a tungsten silicide film in a second deposition step at a temperature below the 680 °C disclosed by Kawanishi. In fact, Kawanishi teaches away from a low-temperature deposition of a tungsten silicide film because “low-temperature treatment [has] a poor adhesion with the substrate and a poor step coverage.” *See, Kawanishi* at p. 4. Understanding Kawanishi, one having skill in the art would not think to combine Kawanishi with a second-step low-temperature deposition because of the resultant undesirable characteristics disclosed by Kawanishi.

Similarly, Price et al. provides no motivation to combine the two-step deposition process of Kawanishi with the Price et al. disclosure to make obvious claim 1. Price et al. teaches a one-step deposition process. Price et al. does not indicate that the one-step deposition process could be combined with two-step deposition processes to improve those processes. This alone demonstrates a lack of motivation to combine Price et al. with Kawanishi because one would not typically think to combine a single-step deposition process with a two-step deposition process to form the deposition process claimed by claim 1 without a disclosed advantage for doing so.

Furthermore, the deposition process of Price et al. requires plasma initiation to activate deposition of the tungsten silicide. Specifically, Price et al. “found that the plasma discharge appears necessary to initiate/nucleate deposition” of tungsten disilicide when using dichlorsilane as a silicon source gas. *See, Price et al.* at col. 5, lines 60-63; col. 9, lines 10-12 (emphasis added). Price et al. does not indicate that a deposition of a tungsten silicide film may be carried out at a low temperature without the plasma initiation. Nor does Kawanishi indicate that it

would be desirable, or even feasible, to use a plasma initiated deposition step in place of the high-temperature deposition step disclosed by Kawanishi. The failure of the two references to motivate a combination with one another precludes the *prima facie* obviousness rejection of claim 1. *See, In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

Contrary to the assertions by the Office, no suggestion or motivation exists in the art that would lead one having ordinary skill in the art to modify or combine the reference teachings to make obvious the claims of the present invention. One of skill in the art would not find it “obvious to deposit the WSi<sub>2</sub> film of Kawanishi at the temperature range suggested by Price” to improve thermal budget because neither reference indicates that a tungsten disilicide film can be deposited using dichlorsilicide as a silicon source gas without a deposition temperature higher than 500 °C or in the presence of a plasma discharge. Kawanishi discloses that a high deposition temperature of at least 680 °C is required to deposit tungsten disilicide using dichlorosilane as a silicon source gas and Price et al. discloses that tungsten disilicide may be deposited from dichlorosilane in the presence of tungsten hexaflouride only after a plasma discharge. Any thermal budget that might be saved by lowering the temperature of Kawanishi’s second-step deposition would surely be offset by the energy required to initiate the required plasma discharge. Additionally, a combination of these references results in either a plasma initiated deposition of tungsten disilicide or a deposition at a temperature greater than the 500 °C limitation recited in claim 1. The lack of motivation based on thermal budget savings precludes a *prima facie* obviousness rejection.

Furthermore, one having ordinary skill in the art would not be motivated to combine Kawanishi and Price et al. based on the assertion that “the application of an old process to make

the same would have been within the level of an artisan.” *See, Official Action* at 6. The reasoning supporting this argument is flawed because Price et al. does not teach that tungsten disilicide may be deposited on a nucleation layer without the presence of plasma. Rather, Price et al. indicates that once a nucleation layer of tungsten disilicide is formed by plasma discharge in the presence of a dichlorosilane silicon source gas, the reaction may continue without the continued presence of plasma. This is not equivalent to a disclosure that dichlorosilane may be used to deposit tungsten disilicide on a nucleated layer without the presence of a plasma discharge at a temperature below 500 °C. The disclosed Price et al. deposition of tungsten disilicide is a single-step process. Nowhere does Price et al. indicate that the deposition may be halted, and restarted, without again initiating the deposition with a plasma discharge. Thus, any combination with Kawanishi would require a deposition temperature over 680 °C or the initiation of the deposition using a plasma discharge for which neither the references nor the art provides any motivation. Claim 1 is allowable over the obviousness rejection because of this lack of motivation. *See, In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

(b) Claim 2

Claim 2 depends on claim 1 and recites the process of claim 1 wherein the reactant gas for reaction with the silicon source gases is hexafluoride (WF<sub>6</sub>). Claim 2 stands and falls with claim 1.

(c) Claim 4

Claim 4 depends from claim 1 and recites the further limitation of “carrying out each of

the (CVD) processes at a temperature of about 400 °C. or less.” Claim 4 is allowable because the combination of Kawanishi with Price et al. is not motivated and because neither reference teaches the limitation of carrying out a two-step CVD deposition process at a temperature of about 400 °C or less for each step of the deposition. *See, In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). Furthermore, claim 4 is allowable as an dependent claim depending from an allowable independent claim. *See, In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596, 1600 (Fed. Cir. 1988)(dependent claims are nonobvious under section 103 if the independent claims from which they depend are nonobvious). Therefore, claim 4 should be allowed over the 35 U.S.C. § 103(a) obviousness rejection.

(d) Claim 5

Claim 5 depends from claim 1 and recites the limitation that the “nucleation layer is formed with discontinuities or to a very thin thickness on the substrate.” Neither Kawanishi nor Price et al. disclose such a limitation. In fact, Kawanishi discloses that “it is preferable to form a thin and uniform film by a low-temperature treatment” rather than a film with discontinuities. *See, Kawanishi*, at p. 7 (emphasis added). Thus, the references fail to teach or suggest all of the claim limitations, thereby precluding a *prima facie* case of obviousness. *See, In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

Claim 5 is also allowable over the 35 U.S.C. § 103(a) obviousness rejection because a dependent claim is nonobvious if the independent claim from which it depends is also nonobvious. *See, In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596, 1600 (Fed. Cir. 1988). In this case, claim 1 is nonobvious, rendering claim 5 nonobvious and allowable.

(e) Claim 8

Claim 8 recites a semiconductor manufacturing process for depositing a tungsten silicide film on a substrate similar to that of claim 1. Like claim 1, claim 8 also includes the following limitation:

depositing a film of tungsten silicide on the nucleation layer using a (CVD) process by switching to dichlorosilane ( $\text{SiH}_2\text{Cl}_2$ ) as a silicon source gas such that the dichlorosilane gas reacts with the reactant gas to form the tungsten silicide film at a temperature of less than about 500 °C.

Claim 8 is allowable over the 35 U.S.C. § 103(a) obviousness rejection for similar reasons to those rendering claim 1 allowable, and claim 8 stands and falls with claim 1.

(f) Claims 9, 12, 13, and 14

Each of claims 9, 12, 13, and 14 are allowable as dependent claims because the independent claim from which they depend, claim 8, is allowable. *See, In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596, 1600 (Fed. Cir. 1988).

Claim 9 recites the process of claim 8 wherein the reactant gas for reaction with the silicon source gases is hexafluoride ( $\text{WF}_6$ ). Claim 9 stands and falls with claim 8.

Claim 12 recites the process of claim 8 wherein “the substrate is silicon wafers and the wafers are heated to a temperature of between 200° to 500°C.” Claim 12 stands and falls with claim 8.

Claim 13 recites the “deposition of the nucleation layer occurs in about 1 to 25 seconds.” Claim 13 stands and falls with claim 8.

Claim 14 recites “a carrier gas includes a mixture of Argon, Nitrogen, and Helium.”

Claim 14 stands and falls with claim 8.

(g) Claim 15

Claim 15 is allowable as a dependent claim depending from an allowable independent claim, claim 8. *See, In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596, 1600 (Fed. Cir. 1988)(dependent claims are nonobvious under section 103 if the independent claims from which they depend are nonobvious). Claim 15 is also independently allowable over the present obviousness rejection because claim 15 recites specific flow rates for the silane silicon source gas, the reactant gas, and the carrier gas, which flow rates are not disclosed by either of the cited references. The failure of the cited references to disclose all of the limitations of claim 15 precludes a *prima facie* obviousness rejection of claim 15. *See, In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). Therefore, the obviousness rejection of claim 15 should be withdrawn and the claim allowed.

(h) Claim 16

Claim 16 depends from claim 1, which is allowable, and is therefore also allowable. *See, In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596, 1600 (Fed. Cir. 1988). Furthermore, claim 16 is independently allowable over the 35 U.S.C. § 103(a) rejection because claim 16 recites the limitation wherein “said depositing said nucleation layer of tungsten silicide and said depositing said film of tungsten silicide occur at a substantially equivalent temperature.” Kawanishi discloses such depositions at two different temperatures and Price et al. only discloses a single-step deposition process. Even if the references are combined, the temperatures of the

Kawanishi's first deposition step and the temperature of the Price et al. deposition step are not substantially equivalent. Thus, the combination of references fails to disclose all of the limitations of claim 16, precluding a *prima facie* obviousness rejection. *See, In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). Claim 16 is allowable.

(i) Claim 17

Claim 17 depends from claim 8, which is allowable, and is therefore also allowable. *See, In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596, 1600 (Fed. Cir. 1988). Furthermore, claim 17 is independently allowable over the 35 U.S.C. § 103(a) rejection because claim 17 recites limitations not disclosed by the combined prior art. Specifically, claim 17 recites the limitation wherein "said depositing said thin or discontinuous layer of tungsten silicide and said depositing said film of tungsten silicide occur at a substantially equivalent temperature." Kawanishi discloses such depositions at two different temperatures and Price et al. only discloses a single-step deposition process. Even if the references are combined, the temperatures of the Kawanishi's first deposition step and the temperature of the Price et al. deposition step are not substantially equivalent. Thus, the combination of references fails to disclose all of the limitations of claim 17, precluding a *prima facie* obviousness rejection. *See, In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). Claim 17 is allowable.

(j) Claim 18

Claim 18 is allowable over the cited obviousness rejection because there is no motivation

to combine the references and because a combination of the references fails to teach or suggest all of the claim limitations recited in claim 18. *See, In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

As with claims 1 and 8, there is no motivation to combine Kawanishi with Price et al. to make obvious the two-step deposition process as recited in claim 18. The lack of motivation is thoroughly described with respect to claims 1 and 8 *supra* and is incorporated herein with respect to claim 18.

Even if a motivation to combine the references does exist, claim 18 is independently allowable. Claim 18 includes the limitation “wherein said depositing said tungsten silicide nucleation layer and said depositing said film of tungsten silicide occur at a substantially equivalent temperature.” The combination of Kawanishi and Price et al. does not teach such a limitation because Kawanishi specifically discloses that the deposition must occur at substantially different temperatures and Price et al. does not disclose a two-step deposition process. Furthermore, the low-temperature deposition disclosed by Kawanishi occurs at 360 °C and the deposition of Price et al. occurs around at least 400 °C. These two temperatures are not substantially equivalent and even if a motivation exists to combine the references, the substantially equivalent temperature limitation of claim 18 is not disclosed. Thus, a *prima facie* case of obviousness does not exist and claim 18 is allowable. *See, In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

Claim 18 also recites the limitation of “switching said silane silicon source gas to said dicholorosilane silicon source gas occurring without interrupting said (CVD) process.” The combination of Kawanishi with Price et al. does not make this limitation obvious because

Kawanishi specifically discloses that following a first deposition to form a nucleation layer the silicon substrate is removed from the reaction chamber and conveyed elsewhere before being conveyed to a reaction chamber for the second deposition step. *See, Kawanishi*, at p. 6. Thus, any combination of Kawanishi and Price et al. results in an interrupted CVD process that fails to make obvious the uninterrupted deposition process of claim 18.

Claim 18 is allowable over the 35 U.S.C. § 103(a) rejection because there is no motivation to combine the references and because even a combination of references fails to teach or suggest all of the claim limitations of claim 18.

(k) Claim 19

Claim 19 is dependent on claim 18 and recites “introducing tungsten hexafluoride (WF<sub>6</sub>) as a reactant gas.” Claim 19 stands and falls with claim 18.

(l) Claim 21

Claim 21 is dependent on claim 18 and recites the further limitation of “carrying out the deposition of said tungsten silicide nucleation layer and said tungsten silicide film at a temperature of about 400 °C. or less.” Claim 21 is allowable because the combination of Kawanishi with Price et al. is not motivated and because neither reference teaches the limitation of carrying out a two-step CVD deposition process at a temperature of about 400 °C or less for each step of the deposition. *See, In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). Furthermore, claim 21 is allowable as an dependent claim depending from an allowable independent claim. *See, In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596, 1600 (Fed. Cir.

1988)(dependent claims are nonobvious under section 103 if the independent claims from which they depend are nonobvious). Therefore, claim 21 should be allowed over the 35 U.S.C. § 103(a) obviousness rejection.

**3. 35 U.S.C. § 103(a) Obviousness Rejections of Claims 3, 6, 7, 10, 11, 20, 22, and 23, Based on the Combination of Japanese Patent No. 2-39528 issued to Kawanishi et al. and U.S. Patent 4,632,057 issued to Price et al., and Further in View of U.S. Patent 4,565,157 issued to Brors et al.**

(a) Claims 3, 6 and 7

Claims 3, 6 and 7 depend from independent claim 1 or a dependent claim depending therefrom. Claims 3, 6, and 7 stand and fall with claim 1.

(b) Claims 10 and 11

Claim 10 depends from claim 8 and claim 11 depends from claim 10. Claims 10 and 11 stand and fall with claim 8.

(c) Claims 20, 22, and 23

Claims 20 and 22 depend from claim 18 and claim 23 depends from claim 22. Claims 20, 22, and 23 stand and fall with claim 18.

(9) APPENDIX

Pursuant to MPEP § 1454, all claims at issue in this Appeal of the Reissue Application are presented in the attached Appendix with all markings necessary to reflect the changes made to the patent claims during the prosecution of this Reissue Application. New claims 16 through 47 are completely underlined.

Respectfully submitted,



Devin R. Jensen  
Registration No. 44,805  
Attorney for Applicants  
TRASKBRITT, P.C.  
P. O. Box 2550  
Salt Lake City, Utah 84110-2550  
Telephone: (801) 532-1922

Date: April 8, 2002

## APPENDIX

Pursuant to MPEP § 1454, all claims at issue in this Appeal of the Reissue Application are presented hereunder with all markings necessary to reflect the changes made to the patent claims during the prosecution of this Reissue Application. New claims 16 through 47 are completely underlined.

1. (Previously Amended) A process for depositing a tungsten silicide film on a substrate comprising:

depositing a nucleation layer of tungsten silicide  $[(WSi_x)]$  on the substrate using a (CVD) process with a silane ( $SiH_4$ ) silicon source gas and a reactant gas; and depositing a film of tungsten silicide  $[(WSi_x)]$  on the nucleation layer using a (CVD) process by switching to dichlorosilane ( $SiH_2Cl_2$ ) as a silicon source gas such that the dichlorosilane gas reacts with the reactant gas to form the tungsten silicide film at a temperature of less than about 500°C.

2. (Previously Amended) The process as recited in claim 1 and wherein:

a reactant gas for reaction with the silane and the dichlorosilane is tungsten [hexafluoride] hexafluoride ( $WF_6$ ).

3. (Previously Twice Amended) The process as recited in claim [2] 1 [and wherein]  
further including:

[the (CVD) process is carried] carrying out each of the (CVD) processes in a cold wall (CVD)  
reaction chamber.

4. (Previously Twice Amended) The process as recited in claim [3] 1 [and wherein]  
further including:

[the (CVD) process is carried] carrying out each of the (CVD) processes at a temperature of  
about 400°C. or less.

5. (Previously Amended) The process as recited in claim [4] 1 and wherein:  
the nucleation layer is formed with discontinuities or to a very thin thickness on the substrate.

6. (Previously Amended) The process as recited in claim [5] 1 [and wherein] further  
including:

[a premix chamber is used to mix] mixing the silane or dichlorosilane silicon source gas, the  
reactant gas and a carrier gas in a premix chamber.

7. The process as recited in claim 6 and wherein:  
a flow rate of the carrier gas is about five to ten times a flow rate of the silane or dichlorosilane  
silicon source gas.

8. (Previously Amended) A semiconductor manufacturing process for depositing a tungsten silicide film on a substrate comprising:

depositing a thin or discontinuous nucleation layer of tungsten silicide [(WSi<sub>x</sub>)] on the substrate using a (CVD) process and reacting a silane (SiH<sub>4</sub>) silicon source gas with a reactant gas in a CVD system having a premix chamber for combining the silicon source gas and the reactant gas; and

depositing a film of tungsten silicide [(WSi<sub>x</sub>)] on the nucleation layer using a (CVD) process by switching to dichlorosilane (SiH<sub>2</sub>Cl<sub>2</sub>) as a silicon source gas such that the dichlorosilane gas reacts with the reactant gas to form the tungsten silicide film at a temperature of less than about 500°C.

9. The semiconductor manufacturing process as recited in claim 8 and wherein: the reactant gas is tungsten hexafluoride (WF<sub>6</sub>).

10. (Previously Twice Amended) The semiconductor manufacturing process as recited in claim [9] 8 [and wherein] further including:

[the (CVD) process is performed] performing each of the (CVD) processes in a cold wall (CVD) system.

11. The semiconductor manufacturing process as recited in claim 10 and wherein: the cold wall (CVD) system includes the premix chamber, a reaction chamber, a graphite boat for holding a plurality of silicon wafers, and means for heating the silicon wafers.

12. (Previously Amended) The semiconductor manufacturing process as recited in claim [11] 8 and wherein:

the substrate is silicon wafers and the wafers are heated to a temperature of between 200° to 500°C.

13. (Previously Amended) The semiconductor manufacturing process as recited in claim [12] 8 and wherein:

deposition of the nucleation layer occurs in about 1 to about 25 seconds.

14. (Previously Amended) The semiconductor manufacturing process as recited in claim [13] 8 and wherein:

a carrier gas includes a mixture of Argon, Nitrogen, and Helium.

15. The semiconductor manufacturing process as recited in claim 14 and wherein:  
a flow rate of the silane silicon source gas is about 400 sccm;  
a flow rate of the reactant gas is about 4 sccm; and  
a flow rate of the carrier gas is about 2800 sccm.

16. The semiconductor manufacturing process as recited in claim 1 and wherein:  
said depositing said nucleation layer of tungsten silicide and said depositing said film of tungsten  
silicide occur at a substantially equivalent temperature.

17. The semiconductor manufacturing process as recited in claim 8 and wherein:  
said depositing said thin or discontinuous layer of tungsten silicide and said depositing said film  
of tungsten silicide occur at a substantially equivalent temperature.

18. (Previously Twice Amended) A process for depositing a tungsten silicide film on a  
substrate using a (CVD) process, comprising:  
introducing said substrate into a reaction chamber of said (CVD) process;  
depositing a tungsten silicide nucleation layer on said substrate by introducing a silane silicon  
source gas and a reactant gas into said reaction chamber such that said silane silicon  
source gas reacts with said reactant gas to form the tungsten silicide nucleation layer; and  
depositing a film of tungsten silicide on said nucleation layer of tungsten silicide by switching  
said silane silicon source gas to a dicholorosilane silicon source gas such that the  
dicholorosilane silicon source gas reacts with the reactant gas to form the tungsten silicide  
film, said switching said silane silicon source gas to said dicholorosilane silicon source  
gas occurring without interrupting said (CVD) process, wherein said depositing said  
tungsten silicide nucleation layer and said depositing said film of tungsten silicide occur  
at a substantially equivalent temperature.

19. (Previously Amended) The process as recited in claim 18 further including:  
introducing tungsten hexafluoride (WF<sub>6</sub>) as a reactant gas for reaction with the silane silicon  
source gas and the dichlorosilane silicon source gas.

20. (Previously Twice Amended) The process as recited in claim 18 further including:  
carrying out the deposition of said tungsten silicide nucleation layer and said tungsten silicide  
film in a cold wall (CVD) reaction chamber.

21. (Previously Twice Amended) The process as recited in claim 18 further including:  
carrying out the deposition of said tungsten silicide nucleation layer and said tungsten silicide  
film at a temperature of about 400°C or less.

22. (Previously Amended) The process as recited in claim 18 further including:  
mixing the silane silicon source gas or dichlorosilane silicon source gas, the reactant gas, and a  
carrier gas in a premix chamber.

23. (Previously Amended) The process as recited in claim 22 wherein:  
a flow rate of the carrier gas is about five to ten times a flow rate of said silane silicon source gas  
or said dichlorosilane silicon source gas.

24. (Previously Amended) A semiconductor manufacturing process for depositing a tungsten silicide film on a substrate comprising:

depositing a discontinuous nucleation layer of tungsten silicide on the substrate using a (CVD) process and reacting a silane (SiH<sub>4</sub>) silicon source gas with a reactant gas in a CVD system having a premix chamber for combining the silicon source gas and the reactant gas; and

depositing a film of tungsten silicide on the discontinuous nucleation layer using a (CVD) process by switching to dichlorosilane (SiH<sub>2</sub>Cl<sub>2</sub>) as a silicon source gas such that the dichlorosilane gas reacts with the reactant gas to form the tungsten silicide film.

25. The semiconductor manufacturing process as recited in claim 24 and wherein: said depositing said discontinuous nucleation layer of tungsten silicide and said depositing said film of tungsten silicide occur at a substantially equivalent temperature.

26. The semiconductor manufacturing process as recited in claim 24 further including:

introducing tungsten hexafluoride (WF<sub>6</sub>) as the reactant gas.

27. (Previously Amended) The semiconductor manufacturing process as recited in claim 24 further including:

performing each of the (CVD) processes in a cold wall (CVD) system.

28. The semiconductor manufacturing process as recited in claim 27 wherein:  
the cold wall (CVD) system includes the premix chamber, a reaction chamber, a graphite boat for  
holding a plurality of silicon wafers, and means for heating the silicon wafers.

29. The semiconductor manufacturing process as recited in claim 24 wherein:  
heating the substrate to a temperature of between about 200° and 500°C., and wherein said  
substrate comprises a silicon wafer.

30. The semiconductor manufacturing process as recited in claim 24 further  
including:  
depositing of the discontinuous nucleation layer for a timespan between about 1 and 25 seconds.

31. The semiconductor manufacturing process as recited in claim 24 further  
including:  
a carrier gas comprising a mixture of Argon, Nitrogen, and Helium.

32. The semiconductor manufacturing process as recited in claim 31 further  
including:  
introducing the silane silicon source gas at about 400 sccm;  
introducing the reactant gas at about 4 sccm; and  
introducing a carrier gas at about 2800 sccm.

33. (Previously three times Amended) A process for depositing a tungsten silicide film on a substrate consisting essentially of:  
depositing a discontinuous nucleation layer of tungsten silicide on the substrate using a (CVD) process with a silane (SiH<sub>4</sub>) silicon source gas and a reactant gas;  
depositing a film of tungsten silicide on the discontinuous nucleation layer using a (CVD) process by switching to dichlorosilane (SiH<sub>2</sub>Cl<sub>2</sub>) as a silicon source gas such that the dichlorosilane gas reacts with the reactant gas to form the tungsten silicide film; and  
wherein said depositing said discontinuous nucleation layer of tungsten silicide and said depositing said film of tungsten silicide occur at a substantially equivalent temperature.

34. The process as recited in claim 33 further including:  
introducing tungsten hexafluoride (WF<sub>6</sub>) as a reactant gas for reaction with the silane and the dichlorosilane.

35. The process as recited in claim 33 further including:  
carrying out each of the (CVD) processes in a cold wall (CVD) reaction chamber.

36. The process as recited in claim 33 further including:  
carrying out each of the (CVD) processes at a temperature of about 400°C. or less.

37. The process as recited in claim 33 further including:

mixing the silane or dichlorosilane silicon source gas, the reactant gas and a carrier gas in a premix chamber.

38. The process as recited in claim 37 wherein:

a flow rate of the carrier gas is about five to ten times a flow rate of the silane or dichlorosilane silicon source gas.

39. (Previously Amended) A semiconductor manufacturing process for depositing a tungsten silicide film on a substrate consisting essentially of:

depositing a discontinuous nucleation layer of tungsten silicide on the substrate using a (CVD) process and reacting a silane ( $SiH_4$ ) silicon source gas with a reactant gas in a CVD system having a premix chamber for combining the silicon source gas and the reactant gas; and

depositing a film of tungsten silicide on the discontinuous nucleation layer using a (CVD) process by switching to dichlorosilane ( $SiH_2Cl_2$ ) as a silicon source gas such that the dichlorosilane gas reacts with the reactant gas to form the tungsten silicide film.

40. The semiconductor manufacturing process as recited in claim 39 and wherein: said depositing said discontinuous nucleation layer of tungsten silicide and said depositing said film of tungsten silicide occur at a substantially equivalent temperature.

41. The semiconductor manufacturing process as recited in claim 39 further including:

introducing tungsten hexafluoride (WF<sub>6</sub>) as the reactant gas.

42. The semiconductor manufacturing process as recited in claim 39 further including:

performing each of the (CVD) processes in a cold wall (CVD) system.

43. The semiconductor manufacturing process as recited in claim 42 wherein: the cold wall (CVD) system includes the premix chamber, a reaction chamber, a graphite boat for holding a plurality of silicon wafers, and means for heating the silicon wafers.

44. The semiconductor manufacturing process as recited in claim 39 wherein: heating the substrate to a temperature of between about 200° and 500°C., and wherein said substrate comprises a silicon wafer.

45. The semiconductor manufacturing process as recited in claim 39 further including:

depositing of the discontinuous nucleation layer for a timespan between about 1 and 25 seconds.

46. The semiconductor manufacturing process as recited in claim 39 further including:

a carrier gas comprising a mixture of Argon, Nitrogen, and Helium.

47. The semiconductor manufacturing process as recited in claim 46 further including:

introducing the silane silicon source gas at about 400 sccm;

introducing the reactant gas at about 4 sccm; and

introducing a carrier gas at about 2800 sccm.

48. (Previously Canceled)

49. (Previously Canceled)

50. (Previously Canceled)